



# Enabling More Automated, Scalable and Cost-Effective Ground Operations

With increasing satellite capabilities and capacity, more services with greater bandwidth will be delivered dynamically whenever and wherever the customer demands it.

In today's traditional ground system environment, delivering a satellite service to a customer can take weeks. The planning and implementation process involves everything from link budgeting, designing the circuit, to cabling and hardware to connect the customer. As service demands pile up rapidly, this hardware centric and manual approach will be challenged to keep pace due to scale, cost and time constraints.

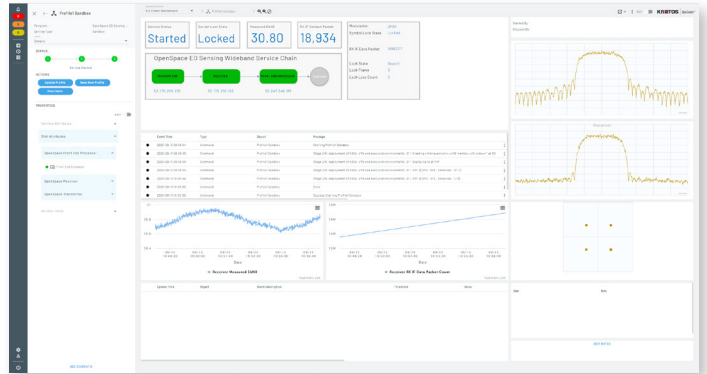
*“Ground network technology must shift from purpose-built, proprietary hardware architectures to software-defined, flexible, and extensible virtual platforms.”*  
- Northern Sky Research

## New Approach Enabling Dynamic Ground System Operations

What if the service could be delivered end-to-end to the customer on demand in just hours with the click of a button? Kratos' OpenSpace™ platform makes this vision a reality. The platform enables the ground system to react dynamically to changes in customer demand, bandwidth supply and threats such as interference and jamming.

## OpenSpace Platform

The OpenSpace platform is the first fully digital, virtualized, software-defined and orchestrated platform in the satellite industry. It is built on an innovative, open and unified architecture that dynamically supports multi-satellite, multi-orbit, multi-payload and multi-band operations.



OpenSpace OpsCenter manages and assures performance across the platform.

## Key Features of OpenSpace

- Open** – standards based with open interfaces
- Cloud native** – all components containerized for scale, High Availability (HA) and redundancy
- Secure** – designed with Zero-Trust architecture

Much more than a bundle of virtual devices, OpenSpace is a centralized platform that uses software control and programmability to automate functions across the ground system from transport, infrastructure and management capabilities.

## On-Ramp to Digital Ground - OpenSpace Digital IF

OpenSpace transforms the ground system from an analog to a fully digital system. As part of the on-ramp to the platform, Kratos' OpenSpace digitizer, known as SpectralNet converts the RF signals from the antenna into network-ready IP packets. The digital stream is then transported reliably and accurately by the OpenSpace WAN Transport Protector (OWTP) Virtual Network Function (VNF) overcoming any potential terrestrial network transport impairments.

- Eliminates duplicative and costly analog equipment
- Assures transport of digital stream over impaired WAN links

## Signal Processing in Software - OpenSpace Virtual Network Functions (VNFs)

With the spectrum fully digitized, the racks of analog hardware, such as splitters, combiners and frequency converters, can be replaced with a functionally equivalent series of Virtual Network Functions (VNF). VNFs move individual network functions out of dedicated hardware devices into software that runs on commodity hardware. The VNFs including software modems, recorders and more perform signal processing on generic x86 servers.

- Reduce costs in hardware, space and power by virtualizing infrastructure
- Scale on demand for growing signal processing needs
- Flexibly support multi-satellite, multi-orbit, multi-payload and multi-band missions
- Deploy on bare metal, virtualized instances or in the cloud

### Dynamic and Virtualized Services - OpenSpace Service Chains

OpenSpace enables network engineers to design and test service templates that stitch together VNFs as a virtual function in a chain for a particular service or mission and associated SLA. There is no need for hardware or cabling just some simple configuration.

These service chains can also specify rules for how to adapt in the face of changing conditions such as interference or weather events. The service chains are developed through a lifecycle process from design, testing, deployment, monitoring and reporting. The virtual service chain lifecycle process includes:

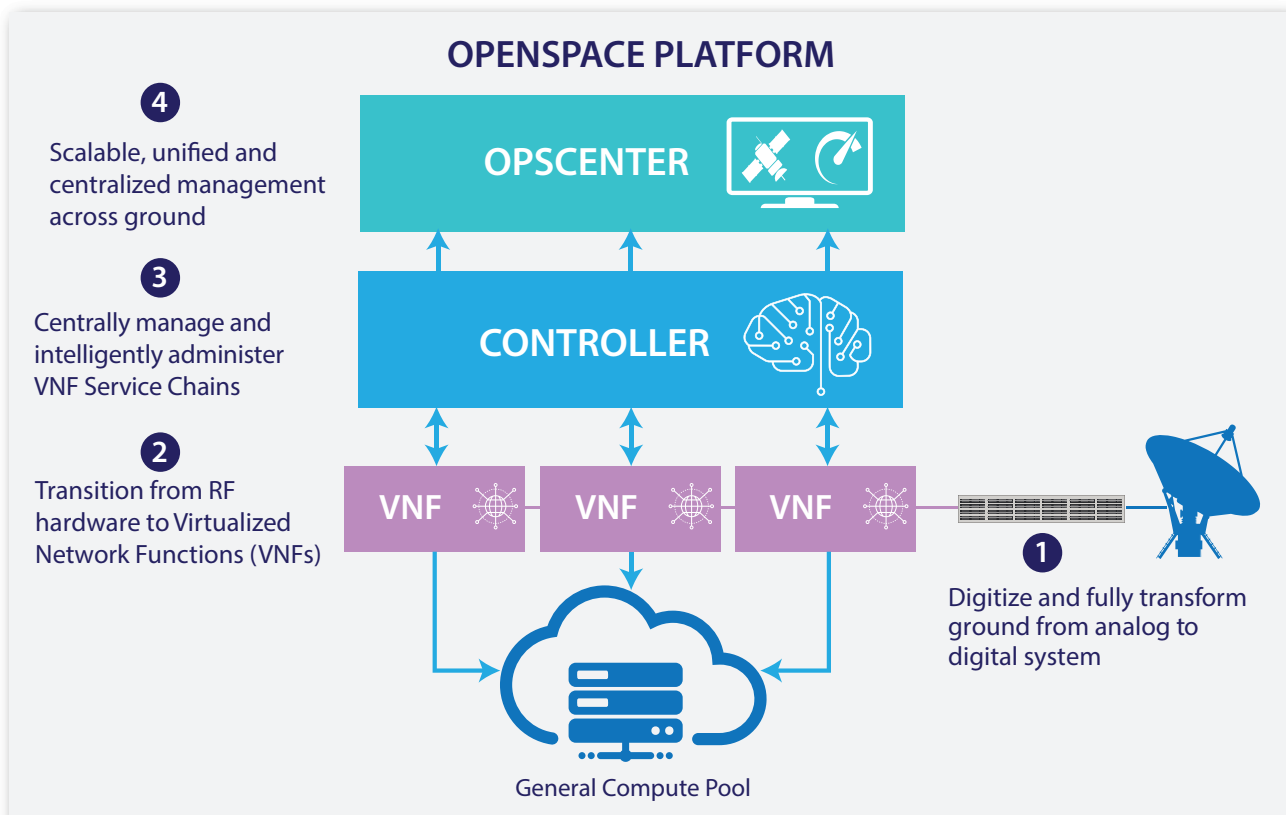
- Design - simplify and accelerate configuration
- Test - minimize configuration errors and assure reliability

- Deploy - spin up and tear down services on the fly, in private or public cloud infrastructures
- Monitor - ensure health and uptime of service chain
- Report - optimize performance, budgeting and planning

### Intelligent Operations - OpenSpace Controller

The OpenSpace Controller is the brain center that controls how service chains are deployed to deliver a given service or mission against a defined SLA or Concept of Operations (ConOps). Based on the OpsCenter service chain template or a third party orchestration framework the controller intelligently sequences the VNFs into virtual service chains to deliver a service. The service chains can be activated and de-activated to dynamically react to changes in supply, demand, and threat.

- Provision services on the fly hundreds of times a day based on demand
- Optimize for missions to support multiple satellites, orbits and missions
- Lower operating costs by automating hundreds of hours of manual tasks and maintenance
- Enhance resilience by reconfiguring the ground system to mitigate failures or threats



OpenSpace enables a more dynamic ground system through these key steps.

## OpenSpace OpsCenter - Unified Management Across the Ground

OpsCenter is OpenSpace's management interface that supports the configuration, administration and monitoring of the ground system including:

- Hardware and legacy devices
- Virtual Network Functions (VNFs)
- Service chains - a connected set of VNFs that deliver a service

OpsCenter enables operations staff to:

- Save time by moving away from manually configuring individual hardware or virtual devices with hundreds of settings in separate element management systems
- Accelerate service delivery by embracing virtual service chains that can be configured in just tens of service-centric settings in a single management system - OpsCenter
- Enable the ground system to instantly respond to changes in supply, demand and threat with dynamic service chains

## Orchestration and OpenSpace

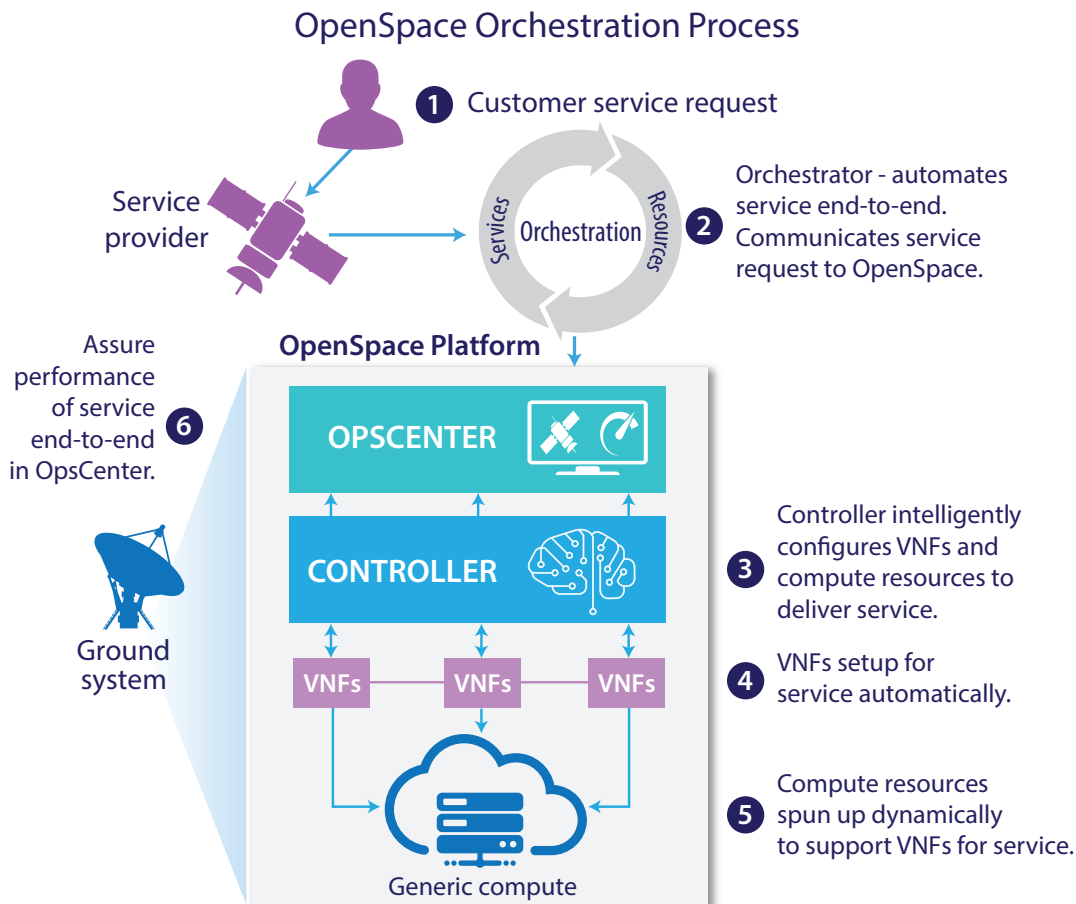
Orchestration is what makes OpenSpace truly dynamic by automating workflows to respond faster to demand,

supply and threat. The OpenSpace platform supports open, third-party service orchestration frameworks to automate an end-to-end service delivery. Satellite operators can use open service orchestration architectures such as ONAP or other industry automation frameworks to communicate directly from their business or mission planning systems to the OpenSpace Controller.

- Save time - accelerate service delivery process – from weeks to hours
- Increase revenue and customer satisfaction - launch more services and get them to market faster
- Optimize efficiency - maximize the usage of network resources to almost 100%
- Reduce costs - automate manual tasks, decrease hardware usage and optimize staff productivity
- Improve QoS – assure service reliability and security

## OpenSpace for Earth Observation and Remote Sensing Missions

In the first release the OpenSpace Platform will be used to automate, fully virtualize and manage Earth Observation (EO) and Remote Sensing (RS) service chains. A number of satellite operators and Ground Station as a Service Providers (GSaaS) in EO and remote sensing have taken the first step by virtualizing



*OpenSpace accelerates service deliver from weeks to hours through the process of orchestration.*

their RF hardware by adopting Kratos' quantum virtual infrastructure products including software modems, recorders and more. Today the proven technology supports tens of thousands of satellite passes per month.

As EO and remote sensing customers look to become more dynamic, fully virtualized and more automated, the OpenSpace platform becomes the next logical step. OpenSpace enables customers to move from virtual to software defined, programmable and dynamic operations.

With OpenSpace, organizations can move from a standalone physical or virtualized capability to fully cloud-centric EO and remote sensing service chains with a controller and management layer to enhance automations and drive scalable operations.

### Enabling More Automated, Scalable and Optimized Operations

Enable more dynamic services by using a completely virtualized and software controlled service chain:

#### OpenSpace Virtual Service Chain – Deliver EO services on the fly on demand

OpenSpace WAN Transport Protector (OWTP) - assures the transport of digitized IP packets across any potential impaired WAN links

OpenSpace Wideband Receiver (ORX) - performs wideband signal processing of 600 Mbps of

throughput to support downlinks across several hundred MHz of instantaneous bandwidth. This is an unmatched level of digital signal processing in software

OpenSpace Stream Processor/Recorder (OSPR) – records satellite-based sensor telemetry or other payload data during a spacecraft pass, providing highly configurable options for CCSDS VCDU filtering and recording

#### OpenSpace Controller – Intelligently configure and deploy service chains dynamically

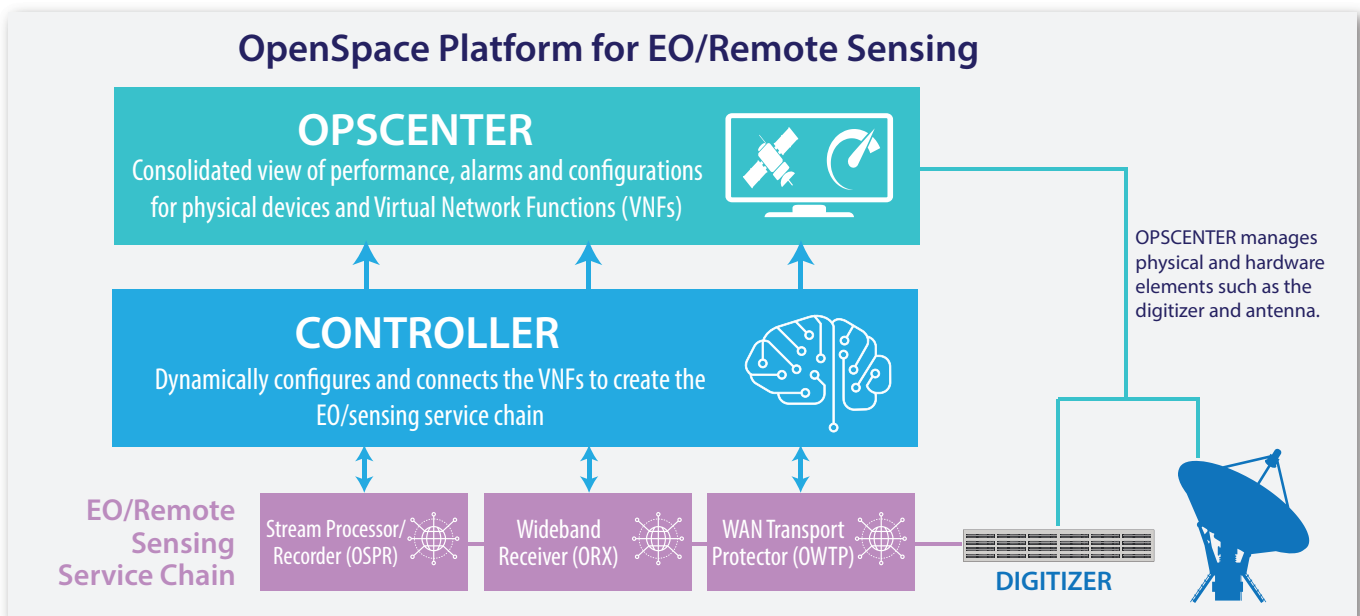
Automate the instantiation of a service chain to receive imaging data from an EO satellite while viewable from a given antenna location

#### OpenSpace OpsCenter –Assure performance and optimize efficiencies through unified management

Gain a consolidated view of the health and status, alarms, and device configurations for physical gateway-based devices and cloud-based VNFs across the ground system

#### Adopting OpenSpace

The OpenSpace Platform can be purchased as a complete platform or in modular building blocks including RF digitizers, the OpenSpace Controller and OpsCenter management functions along with the VNF Service-Chains to meet EO and remote sensing mission needs.



OpenSpace helps automate and scale operations to accelerate service delivery.